

WHAT IS CLAIMED IS:

1. A method of attaching a device to a tissue surface inside of a patient, comprising the steps of:

5 providing a device having a housing, a concavity on the housing, a window to permit visualization through the housing of the interior of the concavity, and a pin which is axially movable from a retracted position within the housing to an extended position which extends at least part way across the concavity;

carrying the device on an introduction instrument into the body;

10 positioning the device at an attachment site in the body such that the concavity is adjacent the tissue surface at the attachment site;

drawing tissue into the concavity;

visualizing tissue within the concavity through the window, and

15 advancing the pin through the tissue to retain the device at the attachment site.

2. A method of attaching a device to a tissue surface inside of a patient as in Claim 1, wherein the device further comprises a lumen in communication with the concavity, and the drawing tissue into the concavity step additionally comprises the step of applying suction to the lumen.

20 3. A method of attaching a device to a tissue surface inside of a patient as in Claim 1, wherein the window comprises a transparent wall on the housing, and said visualizing tissue step comprises observing tissue through the wall of the housing.

25 4. A method of attaching a device to a tissue surface inside of a patient as in Claim 1, wherein the carrying the device on an introduction instrument step comprises carrying the device by an endoscope.

5. A method of attaching a device to a tissue surface inside of a patient as in Claim 1, wherein the pin comprises a material which degrades at the attachment site, and the method further comprises the step of permitting the pin to degrade, thereby releasing the device from the tissue surface.

30 6. A method of attaching a device to a tissue surface inside of a patient, comprising the steps of:

providing a device having a housing, a concavity on the housing, and a pin which is axially movable from a retracted position within the housing to an extended position which extends at least part way across the concavity;

carrying the device on an introduction instrument into the body;

5 positioning the device at an attachment site in the body such that the concavity is adjacent the tissue surface at the attachment site;

drawing tissue into the concavity; and

advancing the pin through the tissue to retain the device at the attachment site.

10 7. A method of attaching a device to a tissue surface inside of a patient as in Claim 6, wherein the device further comprises a lumen in communication with the concavity, and the drawing tissue into the concavity step additionally comprises the step of applying suction to the lumen.

15 8. A method of attaching a device to a tissue surface inside of a patient as in Claim 6, wherein the carrying the device on an introduction instrument step comprises carrying the device on an endoscope.

20 9. A method of attaching a device to a tissue surface inside of a patient as in Claim 6, wherein the pin comprises a material which degrades at the attachment site, and the method further comprises the step of permitting the pin to degrade, thereby releasing the device from the tissue surface.

10. A monitoring device for monitoring at least one physiological parameter at an attachment site in a body, comprising:

a housing, having a tissue attachment surface;

25 a pin which is movable from a retracted position to allow the tissue attachment surface to be brought into contact with tissue at a preselected attachment site, and an extended position in which it extends through tissue in contact with the attachment surface; and

at least one physiological parameter detector carried by the housing.

30 11. A monitoring device as in Claim 10, further comprising a concavity on the housing such that the tissue attachment surface is on a surface of the concavity.

12. A monitoring device as in Claim 10, wherein the pin comprises a bioabsorbable material.

13. A monitoring device as in Claim 11, further comprising a lumen in communication with the concavity, for connection to a vacuum to draw tissue into the concavity.

5 14. A monitoring device as in Claim 10, wherein the physiological parameter detector comprises a pH detector.

15. A monitoring device as in Claim 10, further comprising an RF transmitter for transmitting data generated by the physiological parameter detector.

10 16. A monitoring device as in Claim 10, further comprising an electrical contact for contacting tissue in the body and transmitting data relating to the physiological parameter through the tissue.

17. A method of remotely monitoring a physiological parameter in a body lumen of a patient, comprising the steps of:

15 providing a device having a housing, a physiological parameter detector in the housing, a concavity on the housing, and a pin which is axially movable from a retracted position within the housing to an extended position which extends at least part way across the concavity;

carrying the device on an introduction instrument into the body;

positioning the device at an attachment site in the body such that the concavity is adjacent the tissue surface at the attachment site;

20 drawing tissue into the concavity;

advancing the pin through the tissue to retain the device at the attachment site; and

monitoring at least one physiological parameter.

25 18. A method as in Claim 17, wherein the attachment site is the surface of the esophagus.

19. A method as in Claim 17, wherein the device further comprises a radiofrequency transmitter, and said physiological parameter data transduced by the detector is transmitted to a radiofrequency receiver and a recording device located outside the patient's body.

30 20. A method as in Claim 17, wherein the device further comprises a microprocessor.

21. A method as in Claim 17, wherein the device further comprises a digital recorder that records physiological parameter data.

22. A method as in Claim 21, further comprising the step of transferring the physiological parameter data from the digital recorder to an external data retrieval device.

23. A method as in Claim 17, wherein the physiological parameter is selected from the group consisting of pH, temperature, and pressure.

24. A method as in Claim 23, wherein the physiological parameter data comprises data concerning at least two of said parameters.

25. A method as in Claim 23, wherein the physiological parameter data comprises data concerning all three of said parameters.

26. A method as in Claim 17, wherein the physiological parameter comprises the concentration of ions within a body fluid.

27. A method as in Claim 26, wherein the ions are selected from the group consisting of sodium, potassium, calcium, magnesium, chloride, bicarbonate, and phosphate.

28. A method as in Claim 17, wherein the physiological parameter comprises the concentration of a solute within a body fluid.

29. A method as in Claim 28, wherein the solute is selected from the group consisting of glucose, bilirubin, creatinine, blood urea nitrogen, urinary nitrogen, renin, and angiotensin.

30. A method as in Claim 17, further comprising the step of using a computer and a computer software program to analyze physiological parameter data obtained over a period of time.

31. A method as in Claim 30, wherein the pin used for attaching said monitor to the lumen wall is made at least partially of dissolvable materials.

32. A monitoring device for monitoring at least one physiological parameter at an attachment site in a body, comprising:

a housing, having a tissue attachment surface;

a pin which is movable from a retracted position to allow the tissue attachment surface to be brought into contact with tissue at a preselected

attachment site, and an extended position in which it extends through tissue in contact with the attachment surface; and

at least one physiological parameter detector carried by the housing.

5 33. An implantable device for measuring at least one physiological parameter indicative of gastroesophageal reflux, the device comprising:

a casing adapted to be implanted and secured within the body of the patient in a location wherein the surrounding environment provides the at least one physiological parameter indicative of gastroesophageal reflux;

10 a sensor, positioned within the casing, the is adapted to measure the at least one physiological parameter indicative of gastroesophageal reflux;

a transmitter, positioned within the casing, wherein the transmitter is adapted to send a parameter signal indicative of the measured at least one physiological parameter to a receiver located outside of the body of the patient;

15 a power source, positioned within the casing, that provides power to the sensor and the transmitter;

a processor, positioned within the casing, that periodically induces the sensor to obtain the at least one physiological parameter and periodically induces the transmitter to transmit a parameter signal indicative of the at least one physiological parameter, wherein the processor enables the delivery of power from the power source to the sensor during a first time interval during each measurement cycle when the sensor is sensing the at least one physiological parameter and wherein the processor enables the delivery of power from the power source to the transmitter during a second time interval during each measurement cycle when the transmitter is transmitting the parameter signal so that consumption of power by the sensor and the transmitter is reduced during intervals of each cycle other than the first and second interval respectively.

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30 34. The implantable device of Claim 33, wherein the sensor is comprised of a pH sensor that measures the pH of the fluid surrounding the casing when the casing is implanted in the patient's body.

35. The implantable device of claim 34, wherein the sensor is comprised of an ISFET transistor with an associated amplifier wherein the ISFET transistor is

selectively activated in response to the pH of the fluid surrounding the casing such that the ISFET and the associated amplifier can provide a voltage signal to the microprocessor that is indicative of the pH of the surrounding fluid.

5 36. The implantable device of claim 34, wherein the sensor is comprised of an antimony electrode with an associated amplifier wherein the antimony electrode is selectively activated in response to the pH of the fluid surrounding the casing such that the antimony electrode and the associated amplifier can provide a voltage signal to the microprocessor that is indicative of the pH of the surrounding fluid.

10 37. The implantable device of Claim 33, wherein the transmitter is comprised of an RF transmitter that transmits a digital signal indicative of the physiological parameter indicative of gastroesophageal reflux.

15 38. The implantable device of Claim 33, wherein the processor initiates a measurement cycle wherein the sensor senses the physiological parameter and the transmitter transmits a parameter signal corresponding to the physiological parameter measured by the sensor approximately every 6 seconds.

39. The implantable device of Claim 38, wherein the processor provides power to the sensor only during the first interval and provides power to the transmitter only during the second interval of the cycle so as to reduce power consumption during each cycle.

20 40. The implantable device of Claim 39, wherein the first interval is approximately 20 ms in length and the second interval is approximately 60 ms in length.

25 41. The implantable device of Claim 33, further comprising a non-volatile memory accessible by the processor, wherein the processor is adapted so that calibration information can be stored in the non-volatile memory prior to implantation of the device into the patient.

42. The implantable device of Claim 41, wherein the parameter signals transmitted by the transmitter include the calibration data such that the receiver external to the patient receives a calibrated signal indicative of the physiological parameter indicative of gastroesophageal reflux.

30 43. A method of measuring a physiological parameter indicative of gastroesophageal reflux using an implanted sensor, the method comprising:

(a) providing power to a sensor circuit for a first time interval so as to obtain a parameter measurement indicative of gastroesophageal reflux;

(b) ceasing providing power to the sensor circuit following the first time interval;

5 (c) providing power to a transmitter circuit during a second time interval, following the first time interval so that a parameter signal indicative of the parameter measurement obtained by the sensor circuit can be transmitted to a receiver located outside of the body of the patient; and

10 (d) ceasing providing power to the transmitter circuit following the second time interval.

44. The method of Claim 43, wherein providing power to the sensor circuit comprises providing power to an ISFET transistor that is electrochemically activated by the pH of the fluid surrounding the implanted sensor and that produces a voltage signal that is proportionate to the pH of the fluid surrounding the implanted sensor.

15 45. The method of 44, wherein power is provided to the sensor for approximately 20 ms during the first time interval.

46. The method of Claim 44, further comprising providing a digital signal representative of the physiological parameter measured by the sensor so that providing power to the transmitter circuit results in the digital signal being transmitted to the receiver located outside of the body of the patient.

20 47. The method of Claim 46, wherein providing power to the transmitter circuit during a second time interval comprises providing power to a RF transmitter.

48. The method of Claim 47, wherein power is provided to the transmitter for approximately 60 ms during the second time interval.

25 49. The method of Claim 43, wherein the acts (a) and (b) are periodically repeated every 6 seconds and steps (c) and (d) are periodically repeated every 12 seconds.

50. A system for measuring physiological parameters in the body of a patient indicative of gastroesophageal reflux, the system comprising:

30 a plurality of sensors adapted to be implanted in the body of the patient, wherein the plurality of sensors periodically measure a physiological parameter indicative of gastroesophageal reflux and wherein the plurality of sensors

periodically transmit a signal indicative of the physiological parameter indicative of gastroesophageal reflux and wherein each signal includes an identifier indicative of the sensor from which each signal is sent; and

a receiver that receives the signals from the plurality of transmitters and records the signals.

5 51. The system of Claim 50, wherein each of the plurality of sensors includes a pH monitor and an RF transmitter.

52. The system of Claim 51, wherein each sensor also includes a microprocessor that periodically receives a signal from the pH monitor and induces the RF transmitter to periodically send an RF signal indicative of the pH measured by the pH monitor.

10 53. The system of Claim 52, wherein the microprocessor periodically enables the pH monitor during a first interval of each measurement cycle to obtain the pH signal and then disables the pH monitor during a second interval.

15 54. The system of Claim 53, wherein the microprocessor enables the RF transmitter during the second interval and disables the RF transmitter during periods of each cycle other than the second interval and disables the pH monitor during periods of each cycle other than the first interval.